

SECTION 15250
MECHANICAL INSULATION

PART 1 - GENERAL

0.1 DESCRIPTION OF WORK

- A.** Work Included: This Section specifies furnishing and installing insulation for heating, ventilating, air conditioning, and plumbing systems
- B.** The applicable requirements of Section 15050 - BASIC MATERIALS AND METHODS FOR MECHANICAL WORK shall govern work of this Section.

0.2 DEFINITIONS

- A.** Piping: Piping includes pipe, valves, strainers, and fittings.
- B.** High Temperature Piping: Hot water space heating supply and return; domestic hot water supply and return; vapor vent piping in mechanical rooms; and all piping indicated as any kind of hot or tempered water.
- C.** Low Temperature Piping: Refrigerant suction piping; chilled water supply and return, including integral suction and oil cooler chilled water piping on chillers; and any other piping so indicated.
- D.** High Temperature Equipment: Heating coils, boilers, hot water storage tanks; and air eliminators; boiler breechings, and similar equipment operating at elevated temperatures.
- E.** Low Temperature Equipment: Water chillers, cooling coils; air eliminators; and similar equipment operating at reduced surface temperatures.
- F.** Air Conditioned and Heated Spaces: Are those spaces directly supplied with conditioned or heated air or provided with cooling or heating device.

0.3 SUBMITTALS

- A.** Working Drawings
 - 1. Show layout and complete details for insulation installation including hangers, supports and anchors to be used.
 - 2. Show plan for performing the work including sequence of operations. Verify by field measurements and show on working drawings exact locations of existing utilities. Locations as indicated are approximate and are not intended for use in the preparation of Working Drawings.

- B.** Shop Drawings. Show methods of fabrication, erection, and installation for each different type item that is to be attached to structures of buildings.
- C.** Manufacturer's Literature. Provide manufacturer's literature completely describing products, including installation instructions.

0.4 PRODUCT DELIVERY, HANDLING, AND STORAGE

- A.** Deliver insulation materials with containers clearly marked with manufacturer's stamp or label attached showing manufacturer's name and brand name and type of insulation material by Engineer's designation, Type A, Type B, for example. Additionally, materials or their shipping cartons shall bear label indicating fire hazard ratings.

0.5 JOB CONDITIONS

- A.** Protection
 - 1. Protect unfinished work at end of each workday from damage, contamination and moisture, by use of protective covers. Replace insulation which is damaged, wet, or otherwise contaminated.
 - 2. Cover openings in piping or ducting to prevent entry of insulation materials during installation of materials.
 - 3. Protect surrounding work from damage or contamination by insulation and associated installation materials.
 - 4. Perform work carefully to avoid damage to previously installed finish materials.
 - 5. Follow manufacturer's directions for safe use of materials complying with requirements of Part 2 Articles.
- B.** Scheduling. Inspect, test and accept systems and equipment on which insulation materials are to be installed before starting work on this Section

PART 2 - PRODUCTS

0.1 GENERAL REQUIREMENTS

- A.** Fire Hazard Ratings
 - 1. When tested in accordance with ASTM E 84, NFPA No. 255, or UL723 insulations; including jackets; adhesives, coatings, and sealing compounds; and accessories provided shall have fire hazard rating not to exceed 25 for flame spread and 50 for fuel contributed and smoke developed, when applied separately or if they are factory fabricated they shall have same ratings when tested as assembly, except as follows:
 - a. Flexible unicellular insulation.

- b. Nylon anchors for securing insulation to ducts or equipment.
 - c. Factory pre-molded one-piece polyvinyl chloride fittings and valve covers.
 - d. Treated wood blocks.
- B.** Flameproofing Treatments: Materials subject to deterioration due to the effect of moisture or high humidity will not be acceptable.
- C.** Vapor Barriers: Perm rating not more than 0.05 when tested in accordance with ASTM E 96.

0.2 PIPING INSULATION

A. Types

1. Type A, Mineral Fibre, Pipe Insulation: FS HH-I-558 as follows with vapor barrier, all-purpose jacket where required by Part 3 and presized glass cloth jacket:
 - a. Style 1, Typical Use (Pipe Covering, Molded, for Use thru 450 degrees F): Form D, Type 3, Class 12.
 - b. Style 2, When Used with Premolded One-Piece Polyvinyl Chloride Fitting Covers (Blankets or felts, Flexible): Form B, Type I, for use as follows:
 - 1) For Use Thru 350 Degrees: Class 6.
 - 2) For Use Thru 450 Degrees: Class 7.
2. Type B, Cellular Glass, Pipe Insulation: FS HH-I-551, Type II, provided with Class 4 jacket, all-purpose jacket where required by Part 3 and presized glass cloth jacket.
3. Type C, Cellular Glass, Pipe Insulation: FS HH-I-551, Type II, provided with vapor barrier, all-purpose jacket where required by Part 3 and presized glass cloth jacket.
4. Type D, Calcium Silicate, Pipe Covering for Temperatures Up to 1200 Degrees F: FS HH-I-523, Type 2, provided with Class of jacket as indicated in the Construction Specifications, all-purpose jacket where required by Part 3 and presized glass cloth jacket.
5. Type E, Plastic Unicellular Foam, Tube Type: MIL-P-15280, form T.

B. Schedule of Thicknesses:

Intended Use	Type	Pipe Size	Nominal Inches	Required Insulation Thickness
		1/4 1-1/4	1-1/2 3	3-1/2 10
Anti-Sweat	A	1/2	1/2	3/4

	B	3/4	3/4	1
	E	3/8	1/2	--
Low Temperature	A	3/4	1	1-1/2
	B	1-1/2	1-1/2	2
	E	1/2	3/4	--
High Temperature	A	1	1	1-1/2
	C	1-1/2	1-1/2	2
Anti-Freeze	D	1	1-1/2	2

0.3 EQUIPMENT AND DUCT INSULATION

A. Types

1. Type 1, Mineral Fiber, Blocks and Boards, For Use At Temperatures Thru 400 degrees F., Load Bearing Type: FS HH-I-558, Form A, Class 1; minimum density, three pounds per cubic foot; provided with factory-applied vapor barrier, except if indicted otherwise herein, and presized glass cloth jacket.
2. Type 2, Mineral Fiber, Flexible Blankets, For Use At Temperatures Indicated: Minimum density three-quarter pound per cubic foot, provide with factory-applied vapor barrier, conforming to FS HH-I-558, Form B of following classes as indicated:
 - a. Class 6: For use at temperatures thru 350 degrees F.
 - b. Class 7: For use at temperatures thru 450 degrees F.
3. Type 3, Cellular Glass, Blocks and Special Shapes: FS HH-551, of following types:
 - a. Type I: Blocks
 - b. Type III: Special Shapes
4. Type 4, Calcium Silicate Blocks For Use Up To 1200 Degrees F., On Surfaces Other Than Aluminum or Stainless Steel: FS HH-I-523.

B. Schedule of Thicknesses

1. Low Temperature Equipment Insulation
 - a. Type 1: 1-1/2 inch
 - b. Type 2: 2 inch
 - c. Type 3: 2 inch
2. High Temperature Equipment Insulation
 - a. Type 1: 1-1/2 inch
 - b. Type 3: 2 inch

- c. Type 4: 2 inch
- 3. Ductwork and Plenum Insulation
 - a. Low Temperature Insulation
 - 1) Type 1: 2 inch
 - 2) Type 2: 1-1/2 inch
 - 3) Type 3: 2-1/2 inch
 - b. High Temperature Insulation: Same types as specified above, except with no vapor barrier.

0.4 DUCT AND PLENUM LINING

- A.** General: FS HH-I-545, Type 1 or 2 except as otherwise specified herein.
- B.** Lining thickness: One inch.
- C.** Lining Density: Between 1.35 and 3.3 pounds per cubic foot, designed specifically for lining of ducts.
- D.** Air Velocity Rating: Air-side surface of the liner capable of withstanding air velocity of 4,000 feet per minute without delamination or erosion for service in low-velocity duct systems.
- E.** Liner Composition: Of uniform density, graduated density, or dual density, and coated or uncoated, as standard with the manufacturer.
- F.** Sound Absorption Coefficient: Not less than indicated in table below as determined by procedures in Bulletin XXXI of the Acoustical and Insulating Materials Association, Mounting No. 6.

OCTAVE PASS BANDS	2	3	4	5	6	7
Mid-frequency, Cycles per Second	125	250	500	1000	2000	4000
Sound Absorption Coefficient	.25	.48	.67	.88	.89	.79

0.5 INSULATION JACKETS

- A.** Vapor Barrier Jackets for Piping, Equipment, and Ducts insulation: FS HH-B- 100 of the following types:
 - 1. Piping and Equipment: Type I.
 - 2. Ducts: Type II.

B. Presized Glass Cloth Jackets

1. General. Type with integral vapor barrier may be used in lieu of separate vapor barrier material complying with this Part 2 Article, providing it complies with FS HH-B-100 permeance requirements and type requirements listed herein.
2. Class Cloth Material. Provide material having puncture resistance of not less than 100 when tested in accordance with ASTM D 774; and mold growth resistant.

C. All-Purpose Jackets

1. Type: Manufacturer's standard type complying with the following requirements:
 - a. Physical Characteristics

Physical Properties	Requirements or Limits
Permeance rating ASTM E96, Procedure B in perms	Not more than 0.02
Puncture Resistance, ASTM D781; in Beach units	Not less than 50
Tensile Strength, ASTM D 828, in pounds per inch cross direction	Not less than 35

- D.** Metal Jackets, factory fabricated; aluminum alloy, minimum 0.016 inch thick; having Z-type longitudinal joint seam and minimum two inch wide aluminum circumferential butt joint strips, machine bonded.

- E.** Metal Covers. Aluminum, same alloy and thickness as metal jackets unless otherwise indicated.

0.6 ADHESIVES, CEMENTS, COATING, AND SEALING MATERIALS

- A.** General. Provide materials compatible with materials to which they are applied, and of type that will not corrode, soften or otherwise attach such materials in either wet or dry condition.
- B.** Type A, Lap Adhesive Used for Vapor Barrier Jackets: MIL-A-3316, Class 2.
- C.** Type B, Lagging Adhesive: MIL-A-3316, Class 1.
- D.** Type C, Insulation Cement: FS-SS-C-160, any type except Type II or any other type that contains any asbestos.

- E.** Type D, Bonding Adhesive for Securing Insulation to Metal Surfaces: MIL-A-3316, Class 2.
- F.** Type E, Bedding Compound and Joint Sealers: MIL-B-19564.
- G.** Type F, Tape: Pressure-sensitive vinyl plastic type, as recommended by manufacturer.
- H.** Coating Compounds
 - 1. Type 1, Used as Vapor Barrier: MIL-C-19565, either Type I or Type II.
 - 2. Type 2, Used as Metal Protection: MIL-C-18480.
 - 3. Type 3, Used as Weatherproofing Protective Finish: MIL-C-19565, Type I.
 - 4. Type 4, Used as Vapor Barrier for Fittings on Piping Systems Above 35 Degrees F.: Polyvinyl chloride material conforming to FS L-P-535, Composition A, Type II, any grade unless otherwise indicated.
 - 5. Type 5, Tape, Glass: MIL-C-20079, Type II, Class 1.

0.7 ACCESSORIES

- A.** Insulation Inserts: Provide calcium silicate, cellular glass, prestressed molded glass fiber minimum 13 pound density and same thickness as adjacent insulation.
- B.** Protection Inserts: FS WW-H-171, Type 41, 180 degree type.
- C.** Fasteners
 - 1. Staples
 - a. Material: Aluminum or zinc-coated steel.
 - b. Dimensions
 - 1) Width: Minimum three-quarters of an inch.
 - 2) Thicknesses
 - a) Aluminum: Not less than 0.007 inch.
 - b) Zinc-Coated Steel: Not less than 0.005 inch.
 - 2. Anchor Pins and Speed Washers: As recommended by manufacturer for type and thickness of insulation.
- D.** Bands for Metal Jackets: Minimum three-eighths of inch wide and 0.020 inch thick.

0.8 FABRICATIONS

- A.** Duct Liners
 - 1. Insulation: Two continuous layers of 1/2 inch thick insulation, as specified in Part 2 Article above for duct and plenum lining.

B. Low Temperature Equipment Insulation

1. Form fabricated insulation to fit the equipment.
2. Bevel insulation edges to insure tight joints when insulation is to be used on round surfaces of equipment.

C. For Fittings, Flanges and Valves. Fabricate metal covers of material having same thickness as jacket material on adjacent piping.

0.9 FINISHES

A. Interior Insulation

1. Where Exposed to View But Not Designated to Receive Presized Glass Cloth or All-Purpose Jacket Materials: Apply presized glass cloth or Type 5 coating compound embedded in wet coat of Type B adhesive material.
2. Painting: Section 09900 - PAINTING.

B. Insulation Exposed to Weather

1. Insulation Types Except Type E and Items Designated to Receive Aluminum Jackets or Covers: Apply two coats of Type 3 coating compound.
2. Type E, Insulation: Vinyl lacquer system as specified in Section 09900 - PAINTING.
3. Other Painting: Section 09900 - PAINTING.

PART 3 - EXECUTION

0.1 INSPECTION

- A.** Inspect surfaces to be insulated, and verify that surfaces are dry and free of rust, scale, dirt or other foreign material that would impair application of insulation materials.
- B.** Do not proceed with work of this Section unit unsatisfactory conditions have been corrected.

0.2 PREPARATION

- A.** Stuff or cap-off any openings to prevent entrance of insulating materials into open ducts or building spaces.
- B.** Determine any required precautions for use of materials used for installing insulation materials. Post safety precautions as required.

- C. Clean and pretreat surfaces which are to receive adhesives, paints or other finishes, in accordance with manufacturer's instructions and recommendations.

0.3 INSTALLATION REQUIREMENTS

A. Insulation of Piping Systems

- 1. Piping
 - a. Provide piping with insulation type with or without vapor barriers as scheduled in Part 2 Articles and as indicated. Do not insulate the following:
 - 1) Chrome plated pipes.
 - 2) Pipes used solely for fire protection.
 - 3) Vibration isolating connectors.
 - 4) Access plates or doors in ducts or plenums of air heating systems.
 - b. In addition to requirements of this Part 3 Article, provide piping with all-purpose jacket, except piping exposed to weather or designated to receive Type E piping insulation.
 - c. Where piping is specified to receive both vapor barrier and all-purpose jacket, vapor barrier may be integral with jacket.
 - d. At locations where insulation butts items listed in this Part 3 Article, neatly terminate and bevel adjacent insulation.
 - e. At locations exposed to weather, provide coating compound Type 3 and metal jacketing.
- 2. Fittings, Flanges, and Valves
 - a. Provide insulated fittings, flanges and valves complying with Part 3 Articles herein, unless otherwise indicated.
 - b. At Locations Exposed to Weather
 - 1) Provide fittings except if indicated otherwise herein, flanges, and valves with coating compound Type C and metal covers. Secure covers in place with metal bands and seal with Type 3 coating compound.
 - 2) Provide elbows and curved piping with coating compound Type 3 and factory-fabricated metal covers.

B. Equipment and Duct Insulation

- 1. General. Provide equipment and ducts with vapor barriers as scheduled in Part 2 Articles and as indicated.
- 2. Ducts
 - a. Insulate supply and return ducts unless indicated otherwise. Do not insulate the following:
 - 1) Air conditioning return ducts in air conditioned spaces.
 - 2) Heating return ducts in heated spaces.
 - 3) Ducts with acoustical linings.
 - 4) Ventilation exhaust or return ducts.

- b. Insulate return ducts from outside air intake to air handling unit, including flexible runouts, plenums, and casings.

0.4 INSTALLATION OF INSULATION

A. General

1. Install insulation materials in accordance with manufacturer's instructions and recommendations, Construction Specifications, and as specified herein.
2. Install insulation materials having smooth and even surfaces, with jackets drawn tight and smoothly cemented down longitudinally and at end laps.
3. Neatly finish insulation at pipe and duct hangers.
4. Ensure insulation is clean and dry when installed and during application of finish materials.
5. Install insulation continuous through hangers, sleeves, wall and ceiling openings, except at fire dampers in duct systems.
6. Individually insulate piping and ductwork.
7. Where plumbing pipes are located in wall chases and space does not permit installation of sectional insulation, when accepted by the Engineer, indicated piping insulation may be omitted provided chases are packed full of either mineral fiber or rock wool.
8. Provide complete moisture and vapor seal wherever insulation terminates against metal hangers, anchors and other projections through insulation on cold surfaces designated to receive vapor seal.

B. Installation Pipe Insulation

1. Sectional Pipe Insulation Except Type E
 - a. Place sections of insulation around pipe and tightly butt into place. Additionally, install pipe insulation such that section butt joints occur at intervals as indicated on continuous pipe runs.
 - b. Apply Type 1 coating compound to jacket laps, then draw laps tight and smooth and secure with staples spaced not more than four inches on center and one inch from edge of lap, except do not use staples to secure jacket laps on pipes containing fluid medium at temperatures below 35 degrees F.
 - c. Insulation Joints
 - 1) Circumferential
 - a) Cover with butt strips, not less than three inches wide with material same as insulation jacket material.
 - b) Secure butt strips with Type 1 coating compound and secure with staples installed on both edges of butt strip, except staples may be omitted when factory-applied self-sealing system is used unless fishmouths develop.
 - c) Seal staples and seams with one coat of Type 1 coating compound.

- 2) Butt Joints
 - a) Seal ends of pipe insulation with Type 1 coating compound that butt fittings, flanges and valves, and insulation butt joints on continuous runs of pipe.
 - d. Penetrations
 - 1) At penetrations fill voids in insulation with Type 1 coating compound and seal penetration with coat of same material.
2. Sectional Pipe Insulation Type E
 - a. Install insulation by either slipping over piping or split insulation and place it around piping.
 - b. Joints
 - 1) Butt and Ends Joints. Seal butt joints and ends of pipe insulation with either Type F sealing material or Type A adhesive material.
 - 2) Longitudinal Joints. Seal joints with Type A adhesive material and secure with Type F sealing material minimum nine inches on center.
3. At Hangers, Sleeves and Pipes Two Inches and Larger
 - a. Install insulation continuous through pipe hangers and sleeves.
 - b. At hangers where pipe is supported, provide insulated protection shields.
 - c. At Pipes Two Inches and Larger:
 - 1) Insulation Inserts. Provide inserts at hanger support points complying with following requirements:
 - a) Having length not less than length of protection shields.
 - b) Having sufficient compressive strength to adequately support pipe without compressing inserts to thickness less than adjacent insulation.
 - 2) Face inserts with vapor barrier material same as facing on adjacent insulation.
 - d. At Pipes Passing Through Sleeves
 - 1) General. Install metal jacket over insulation where caulking is required.
 - 2) Interior Walls. When penetrating walls, extend metal jacket minimum two inches of either side of wall and secure each end with band.
 - 3) Floors. When penetrating floors, extend metal jacket from point below backup material to point minimum 10 inches above floor unless otherwise indicated, and provide one band at floor and one minimum one inch from end metal jacket.
4. Elbows, Fittings, Valves Unions and Anchors
 - a. General. After segments of piping insulation are installed, cover flanges, elbows, fittings, valves, unions and anchors.
 - b. Elbows. Cover with not less than three segments of insulation.
 - c. Other Fittings and Valves
 - 1) Either cut segments to required curvature, or use nesting size sectional insulation.
 - 2) Place and join segments of insulation with Type E adhesive.

- 3) After segments are installed, apply one coat of Type 1 coating compound.
- d. Unions
 - 1) Where unions are indicated not to be insulated, terminate covering neatly at union ends with Type C cement material, trowelled on bevel.
 - 2) Apply one coat of Type 1 coating compound to beveled ends.
- e. Anchors
 - 1) Insulate anchors same as adjacent piping for distance not less than six inches from surface of pipe insulation, unless otherwise indicated.
 - 2) Apply one coat of Type 1 coating compound.
5. Installation Metal Jacketing
 - a. Apply metal jacketing over outer layer of insulation on piping flanges, valves and other fittings.
 - b. Secure jackets to pipe insulation using only butt straps machine bonded.

0.5 INSTALLATION OF DUCT AND PLENUM INSULATION

A. Methods of Installation

1. Rigid Duct Insulation
 - a. Fastening System
 - 1) General. Provide pin or anchor type fasteners.
 - 2) Secure fasteners to duct surfaces with Type D adhesive.
 - 3) Install fasteners located more than three inches from edge of rigid insulation materials and spaced on not more than 12 inch centers.
 - b. Installation Method
 - 1) Install insulation by impaling on fastener system in such a manner that joints between adjacent pieces of insulation material are tightly butted.
 - 2) Secure insulation with washers and clips.
2. Non-Rigid Duct Insulation. Install in accordance with requirements specified in the Construction Specifications.

0.6 INSTALLATION OF EQUIPMENT INSULATION

A. General. Insulate equipment with types of insulation as scheduled in Part 2 Articles and as indicated.

B. Chilled Water Pumps and Air Separators

1. General
 - a. Provide type and thickness of insulation as schedule and indicated.

- b. Cut insulation to fit, fill voids and joints with type adhesive as specified in the Construction Specifications, install glass cloth jacket and apply finish coating.
- c. At Pumps: In addition to above, install insulation split along line of pump flanges and along sides of pump body and seal joints with tape; arrange insulation to be removed by splitting tape that seals joints.

0.7 ADJUSTING AND CLEANING

- A. Fill joints, breaks, and punctures in insulation materials with Type 1 coating compound and cover with vapor seal material identical to adjacent materials in accordance with manufacturer's instructions and recommendations.
- B. Clean installed insulation surfaces.
- C. Remove scrap materials and adhesives.

PART 4 - MEASUREMENT AND PAYMENT

0.1 GENERAL

- A. No separate measurement or payment will be made for work required under this Section. All costs in connection therewith shall be considered incidental to the item or items of work to which they pertain.

END OF SECTION